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PREPACKAGING PEARS AT SHIPPING POINT

Marketing Research Report No. 758

Agricultural Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE

PREFACE

This is one of several reports on research undertaken by the Agricultural Research Service to develop improved consumer packages and shipping containers for agricultural products. This packaging research program is aimed at reducing the cost of marketing agricultural products and improving the quality of products available to consumers.

Researchers and technicians of several packaging-material and equipment companies cooperated by designing and developing new or improved packages, containers, and equipment. These firms included Diamond National Corp., New York, N.Y.; E. I. du Pont de Nemours & Co., Wilmington, Del.; The Goodyear Tire & Rubber Co., Akron, Ohio; W. R. Grace & Co., Duncan, S.C.; and Keyes Fibre Co., Waterville, Maine.

Several organizations cooperated in the study by furnishing packaging materials, experimental equipment, facilities, and labor and by assisting in conducting various experiments in pear-packing plants and arranging transcontinental test shipments. They included Blue Star Growers, Inc., Cashmere, Wash.; California Fruit Exchange, Sacramento, Calif.; Harry & David, Medford, Oreg.; Nye & Naumus, Medford, Oreg.; Oregon-Washington-California Pear Bureau, Portland, Oreg.; Placerville Fruit Growers Association, Placerville, Calif.; and Stadelman Fruit Co., Inc., Yakima, Wash.

The assistance and cooperation of these firms and of many transportation agencies, wholesalers, and retailers are gratefully acknowledged.

Philip W. Hale, Robert Tom Hinsch, and Donald R. Stokes, Transportation and Facilities Research Division, assisted in the collection and analysis of data.

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PREPACKAGING PEARS AT SHIPPING POINT

By James B. Fountain, *agricultural economist*, and Peter G. Chapogas, *agricultural marketing specialist, Transportation and Facilities Research Division, Agricultural Research Service*

SUMMARY

Packaging pears in consumer trays at shipping point costs about 1½ cents more per pound for packaging, transport, storage, and overhead than place-packing pears in standard wood boxes.

A molded-pulp pear tray and fiberboard shipping containers to hold the packaged trays were designed. All nine of the commercially important pear sizes can be packaged in the tray. The pear tray protected pears better than three fruit trays tested. Two heat-shrinkable films tested as overwraps for the trays immobilized the pears and minimized skin discoloration. Although some film wrinkling occurred at time of packaging and some trays became distorted during long periods of storage, package appearance was usually satisfactory and the pears were salable.

In 23 transcontinental rail test shipments, hard and green pears packaged in consumer trays and packed in fiberboard shipping containers arrived in eastern markets with less bruising and discoloration than similar pears place-packed in standard wood boxes. The trays were packed in five and six layers in the shipping containers, with pads on top to form a compression pack. The pears were held in cold storage for up to 6 months before shipment.

About 200 commercial carloads of prepackaged pears were shipped by cooperating firms, and 61 of these shipments were examined by researchers. In the 1960–61 and 1961–62 seasons, 54 of the shipments confirmed the results of the test shipments with green pears, but in the 1962–63 season, Anjou pears in 3 out of 7 shipments arrived in unsatisfactory condition because some of the fruit was partially ripened.

Methods of packing pears that have been allowed to ripen before shipment also were tested. The types of pack used for these pears were (1) the compression pack developed for hard and green pears, but with pads between each layer of trays; (2) a slack pack, with pads between layers but with space at the top of the container; and (3) a compartment pack, with horizontal and vertical partitions that held each tray in a separate compartment. Injury to the pears in all three packs in four test shipments was less severe than that to similar pears that had been shipped in the compression pack developed for hard and green pears.

Wholesalers and retailers generally liked the prepackaged pears, but some thought that the shipping containers were too heavy, and the appearance of the packages was not always satisfactory.

INTRODUCTION

The three Pacific Coast States of California, Oregon, and Washington produce about 90 percent of the fresh pears marketed in the United States. About half the pears grown in these States are Bartlett and the remainder are winter pears —Anjou, Bosc, Comice, and several other varieties such as Hardy and Winter Nelis.

Winter pears are usually harvested when they are hard and green, packed in standard boxes that are used both as storage and shipping containers, and stored for as long as 6 months before shipment. The commonly used "standard" box for pears is of wood with inside dimensions of 18 by 11½ by 8½ inches. Each pear is wrapped in tissue paper and place-packed in this box.

The standard box has the following disadvantages: (1) Complicated packing procedure requires skilled labor, (2) pressing the lid into position to keep the pears from moving causes some bruises and cuts, and (3) opening and reclosing the box are difficult.

Shipping containers are not generally used for retail display. With few exceptions, pears are repacked in consumer packages or displayed loose on retail counters. Pears should be handled as little as possible to avoid damage. Rehandling of pears at retail stores, plus the repeated handling by consumers as the pears ripen on display, causes bruising and skin discoloration. The sale of bruised, cut, or discolored pears either in consumer

packages or in loose displays causes consumer dissatisfaction and may reduce sales of fresh pears.

Previous experiments in prepackaging pears at shipping point, both in window cartons and in unwrapped consumer-size molded-pulpboard trays, were not successful because of high costs, inadequate protection from bruising and skin discoloration, and poor salability.

Packaging pears in consumer packages at shipping point (prepackaging) has these advantages: (1) Use of less skilled packing labor, (2) reduced waste and spoilage, (3) more efficient handling in retail stores, (4) better merchandising through brand identification and more effective means of giving information to consumers through recipes and handling and ripening instructions, and (5) opportunity for consumers to buy more attractive pears of uniform quality.

REQUIREMENTS FOR CONSUMER PACKAGES AND SHIPPING CONTAINERS

Consumer packages designed for prepackaging pears at point of production should be constructed of low-cost material. They should be economical to procure, store, fill, and close. They must provide good product visibility, with adequate means for escape of gases and water vapor.

The consumer package and shipping container should have enough strength to protect the pears and maintain acceptable appearance during several months of cold storage, several days in transit, and several days during terminal market distribution through wholesale houses and retail stores.

The consumer package should not have sharp edges that would injure the pears and preferably should provide some cushioning. To prevent rubbing and resultant skin discoloration, pears must be immobilized by pressure or some other means.

The large number of pear sizes packed makes it difficult to design one package to fit all sizes. Of the 15 recognized sizes, 9 are most important in the commercial distribution of fresh pears. Having a separate package for each size would require nine different packages. To minimize the number of different packages, a package should be flexible enough to hold at least three sizes and shapes of the four major varieties.

Since maximum visibility for merchandising is desirable, transparent packaging materials that enhance the natural appearance of the pears should be used.

The capacity of the shipping container should be about 50 pounds. Less than this would result in a higher cost per pound of pears. Containers in excess of 50 pounds are hard to handle. To keep container inventory at a minimum, the shipping container should hold at least half the package sizes so that only two sizes of containers would be needed.

PROCEDURE

A molded-pulp pear tray and shipping containers to hold the trays were designed. Commercially available films and two new heat-shrinkable films were evaluated as tray overwraps.

Test shipments of pears were made to determine the amount of injury to pears caused by (1) the molded-pulp pear tray, compared with three other trays designed for packaging various round fruits and (2) the shipping containers holding packaged pears, compared with standard wood boxes of place-packed, wrapped pears.

Tests to determine the effect of tray design on pear injury were made with conditioned pears,[1] so that injury could be more readily determined. Four controlled rail test shipments of conditioned pears in the pear tray and three other trays were made from Yakima, Wash., to New York, N.Y., in March and April 1964.

Tests of three shipping containers, designed to hold three, five, and six layers of trays, were made with hard and green pears that had been packed and held in cold storage for 2 to 6 months.

The shipping container designed to hold three layers of pears prepackaged in pulp trays was evaluated by conducting four controlled test shipments of Bartlett pears and six test shipments of Anjou pears during the 1959–60 season.

Early in the 1960–61 season, one preliminary test shipment of prepackaged Bartlett pears packed in five- and six-layer shipping containers was made. Test containers for this shipment had compression pads on top of the pack and they were packed with and without pads between layers. All packs were slightly overfull and were called compression packs. Thirteen test shipments during the 1960–61 and 1961–62 seasons were made with Bartlett and Anjou pears packed in five and six layers without layer pads. The five- and six-layer shipping containers were further

[1] Average pressure test (Magness-Taylor $\frac{5}{16}$-inch head) was 11.6 pounds at time of shipment.

evaluated during the 1960–61, 1961–62, and 1962–63 seasons by examining the arrival condition of 61 commercial shipments of full carloads of prepackaged pears—Bartlett 16 cars, Anjou 29 cars, Bosc 14 cars, and Comice 2 cars.

Three additional shipping containers for conditioned or ripened pears with different types of packs were evaluated in conjunction with the tests of trays. Two containers had pads between each layer of consumer packages, but one was a compression pack and the other was a slack pack. The slack pack was full when packed but settled in transit so there was space between the top of the box and the contents. The other container was designed to hold consumer packages in separate cells or compartments and is referred to in this report as a compartment pack.

All shipments had four to six test and control containers packed with comparable pears loaded in different locations in the cars.

Pears in the 61 commercial shipments were examined by inspecting containers (usually 10–15 per carload) representing different pear sizes and locations in the car.

The effect of the trays, shipping containers, and various packs on the amount of bruising and discoloration was determined by inspecting individual pears. The various degrees of injury are defined as follows:

Degree of injury	*Definition*
Slight	¼ to ¾ inch in diameter or equivalent area, less than ⅛ inch deep.
Damage	¾ to 1 inch in diameter or equivalent area, less than ⅛ inch deep.
Serious	1 inch or more in diameter, or more than ⅛ inch deep: unsalable fruit.

Costs of packaging materials used and direct packing labor were obtained by making studies in cooperating pear-packing plants. Prices of the materials were obtained from package and container manufacturers. The cost of transportation was based on the number of containers loaded per car and 1964–65 transport charges.

DEVELOPMENT AND PERFORMANCE OF TRAYS AND OVERWRAPS

Trays

Redesigning molded-pulp trays to perform better as a pear package was evolutionary. The first molded-pulp trays used for pears in 1958 had raised cones or pyramids to form pockets for each fruit (fig. 1, *A*). This design limited the number of pear sizes that could be packaged in a single tray. With two pyramids, only six pears could be placed in the tray. To package eight smaller pears, a different size tray with three raised pyramids was made. In 1959, a new, less expensive pulp tray with a raised longitudinal divider was developed (fig. 1, *B*). Replacing the pockets with a longitudinal divider permitted the placement of many sizes, varieties, and shapes of pears in the same tray. This tray was modified to increase rigidity and visibility (fig. 1, *C*). This is the pear tray used in this study. It has a broad, gently rounded longitudinal divider that extends the length of the tray. To add rigidity and strength to the tray, the divider was crimped at a point three-eighths inch from each end.

From 1960 to 1964, several other types of pulp trays became available and were used by pear packers. These were called "fruit" trays. They had shorter, narrower dividers, with sharper edges and large gaps at the ends (fig. 1, *D* and *E*). These narrower dividers permit the packaging of round fruit, such as apples and peaches, as well as pears.

All the trays were five-eighths to three-fourths inch in depth. The pear tray was 9 by 5⅞ inches and the fruit trays were one-fourth to three-eighths inch shorter.

Figure 2 shows three varieties of pears packaged in the pear tray and their interlocking position. Large pears are placed at right angles to the divider; smaller ones are placed at a slight angle. The necks of the pears rest on the divider, raising the fruit to improve package appearance and provide a flat surface for better packing in the layers of the shipping containers. All nine of the commercially important sizes of pears were packaged in this tray (table 1).

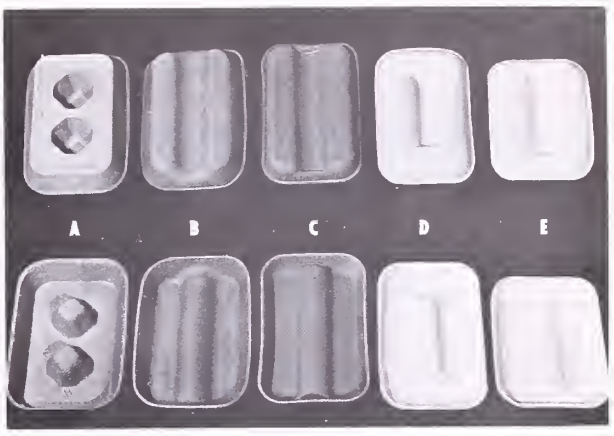

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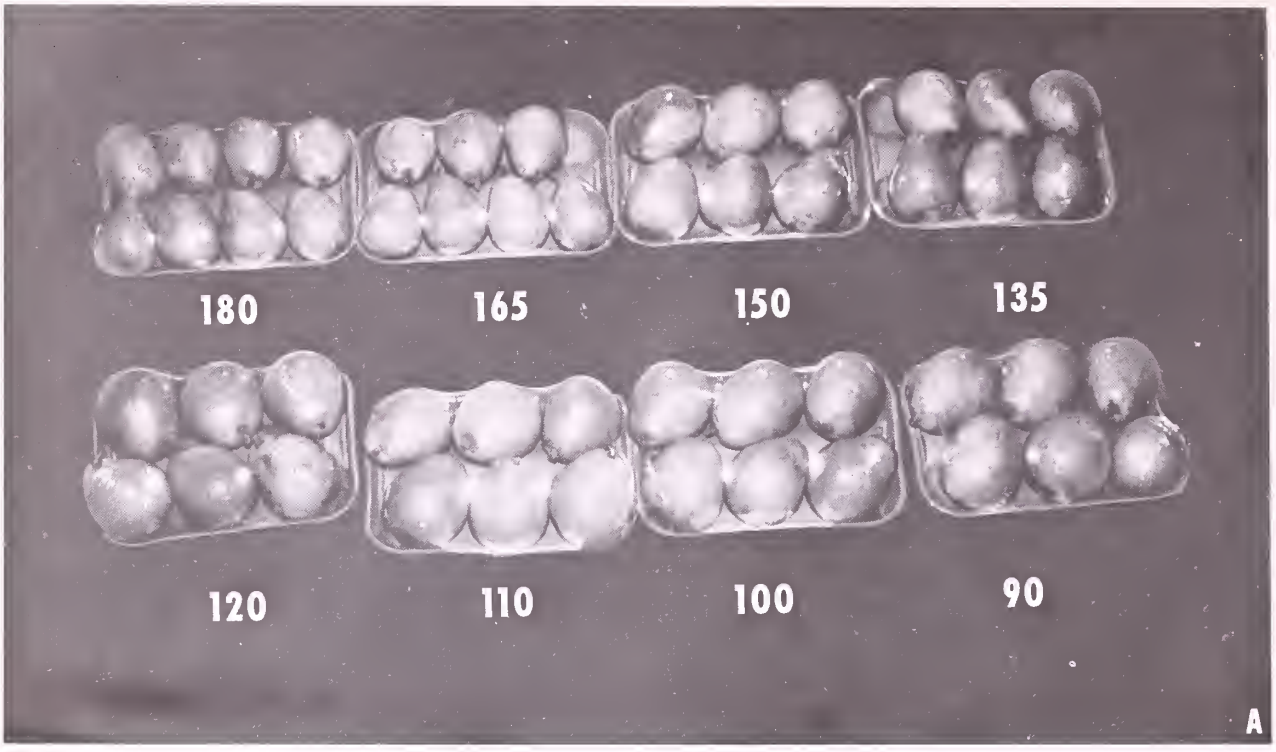
FIGURE 1.—Design evolution of molded-pulp trays for pears: *A*, For round fruit: *B*, first tray designed specifically for pears: *C*, modified pear tray, with longitudinal divider crimped to increase rigidity and sides lowered to increase visibility: *D* and *E*, "fruit" trays for pears and round fruit.



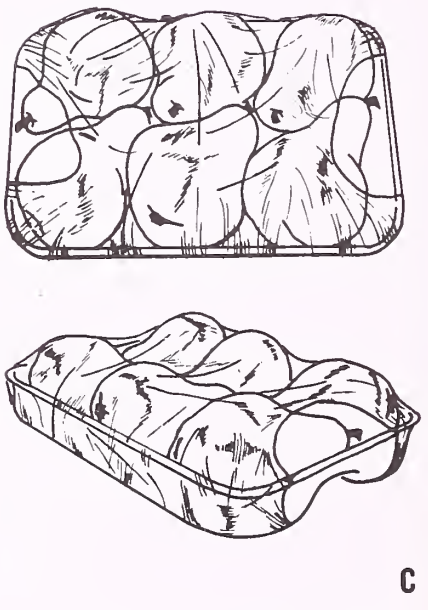


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FIGURE 2.—Pear varieties in pear tray: *A*, Eight sizes of Anjou: *B*, four sizes of long-necked Bosc: *C*, Bartlett. with band of shrink film that immobilizes pears and leaves ends of package open.

TABLE 1.—*Description of Anjou, Bartlett, Bosc, and Comice placement by size in pear tray and weight of package*

Pear size [1]	Pears per tray	Calculated weight of package [2]	Remarks
	Number	*Pounds*	
80	4	2.25	Round pears and heavier 80's can be packaged 4 per tray.
	5	2.81	Typically shaped lightweight 80's can be packaged 5 per tray.
90	5	2.50	5 pears fit well.
100	5	2.25	5 pears fit well; some packers place 5 and others 6 in tray.
	6	2.70	
110	6	2.45	6 pears of all varieties fit well.
120	6	2.25	Do.
135	6	2.00	Often slightly slack appearance.
150	6	1.80	Slack appearance, but does not seem to affect salability.
165	7	1.91	Most can be packaged 7 per tray, but if too heavy or exceptionally short and round, 7th pear is difficult to place. 6 pears result in very slack package.
180	8	2.00	8 pears fit well.

[1] Based on number of pears packed in standard wood box.

[2] Based on average 45-pound net weight for standard wood box.

Differences in injury caused by the design of the pear and fruit trays in four controlled rail test shipments in 1964 are shown in table 2. In each shipment, 75 packages of the pear tray and of each of the three fruit trays were randomly packed in 12 master containers. At time of shipment, the average pressure test (Magness-Taylor $\frac{5}{16}$-inch head) was 11.6 pounds, and at time of evaluation it was 5.6 pounds. The sharp edges of lengthwise dividers in the fruit trays caused most of the bruising and discoloration (fig. 3). The pears in the pear tray sustained significantly less bruising and discoloration from all causes than the pears in the fruit trays.

The appearance of the test packages was rated. The pear tray, because it was less rigid, did not maintain as good package appearance as the fruit trays. Figure 4 illustrates how the pear tray was distorted by conforming to the shape of pears during long-term storage (2–6 months). This tray can be modified so that its rigidity is increased without changing the desirable features that protect the pears.

Overwraps

Various films—polyethylene, polyester, cellophane, and polyvinylidene chloride-coated cellophane—tested for overwraps in 1959–60 were found (1) to be fairly costly, (2) not to be tight enough to immobilize the pears, and (3) to require too much labor for wrapping. The coated cellophane film discolored pear lenticels.

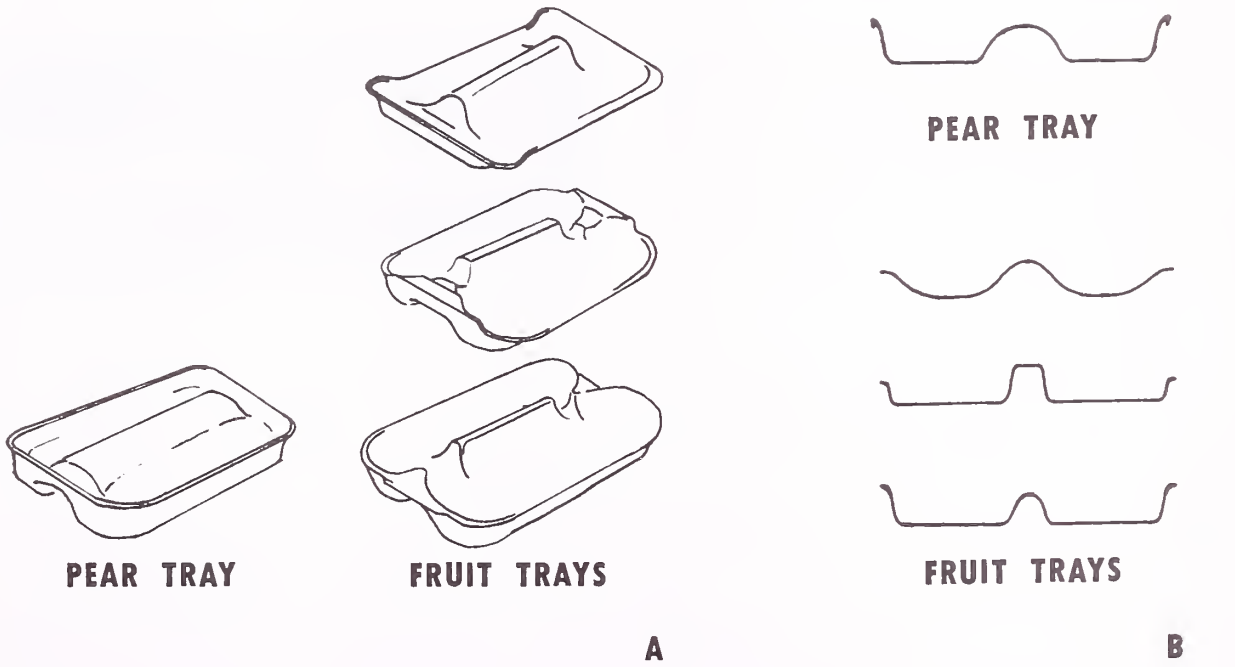

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FIGURE 3.—*A*, Pear tray and three types of fruit trays: *B*, cross-section view at center of trays.

TABLE 2.—*Effect of tray design on injury to prepackaged Anjou pears in 4 rail test shipments, Yakima, Wash., to New York, N.Y., March and April 1964*

Injury, type of tray, and cause of injury	Degree of injury			
	Very slight [1]	Slight	Damage	Serious
BRUISING	*Percent*	*Percent*	*Percent*	*Percent*
Pear tray:				
Tray divider [2]	1.9	0.1	0	0
Tray edge	4.3	0	0	0
Vertical pressure	2.8	.1	0	0
Pressure of pear against pear	2.4	0	0	0
Total	11.4	.2	0	0
Fruit trays:[3]				
Tray divider [2]	24.9	1.8	.1	0
Tray edge	2.3	([4])	0	0
Vertical pressure	3.6	.2	0	0
Pressure of pear against pear	3.8	([4])	0	0
Total	34.6	2.0	.1	0
DISCOLORATION				
Per tray:				
Tray divider [2]	2.0	0	0	0
Tray edge	.2	.1	0	0
Other	1.1	.1	0	0
Total	3.3	.2	0	0
Fruit trays:[3]				
Tray divider [2]	10.5	.4	([4])	0
Tray edge	.5	0	0	0
Other	.9	.1	([4])	0
Total	11.9	.5	([4])	0

[1] Less than ¼ inch in diameter or equivalent area and very slight depth.
[2] Differences significant at 99-percent level.
[3] Average of 3 fruit trays.
[4] Less than 0.1 percent.

During these wrapping experiments, heat-shrinkable films became available. Their principal advantage is the immobilization of pears in trays. This feature makes it possible to use a sleeve wrap instead of a complete overwrap and reduces the amount of film required and the amount of labor for wrapping. In addition, shrink film automatically forms a neat wrap as it shapes itself to the contour of the pears and thus frees the workers from performing this task.

Two types of heat-shrinkable films were used. The polyethylene shrink film was 1 mil thick, strong, and clear, with 50- to 80-percent equal shrink in all directions. The packaging method used for polyethylene shrink film is shown in figures 2, *C*, and 4. Although various widths were tried, a 13-inch-wide band of film was found adequate for all sizes of pears packaged in the trays. When narrower widths were used, pears fell out of the trays.

The polyvinyl chloride film was three-fourths mil thick, clear, and strong, with approximately 40-percent lengthwise (machine) and 6-percent crosswise shrink. Because of the latter shrinkage, it is possible to use 11-inch-wide film rather than the 13-inch width required for biaxially oriented

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FIGURE 4.—Pear tray wrapped with band or sleeve of shrink film. During 4 months' storage, tray absorbed moisture, softened, and conformed to shape of pears.

polyethylene shrink film. The packaging method for polyvinyl chloride film was similar to that for the polyethylene film.

These films immobilized the pears within the trays and helped reduce skin discoloration. After long storage and transcontinental shipment, the packages were salable, but did not always have a bright "just packaged" appearance. Package-appearance deterioration usually resulted from film wrinkling at time of shrinking, from tray distortion caused by moisture absorption, and from loosening of the film wrap.

DEVELOPMENT AND PERFORMANCE OF SHIPPING CONTAINERS

The first step in the development of shipping containers was a study of package placement. A three- by two-package layer pattern was developed, with three packages placed crosswise and two lengthwise. This pattern is reversed alternately by layers (fig. 5).

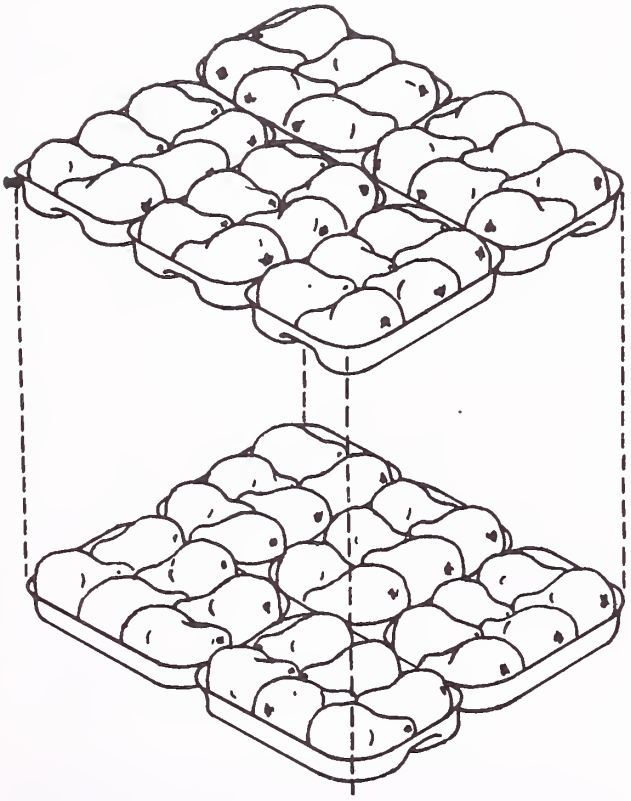

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FIGURE 5.—Three- by two-package layer pattern alternately reversed by layers.

Three Layers

Full-telescope corrugated fiberboard boxes tested in the 1959–60 season held a three-layer pack consisting of 15 consumer packages, 5 per layer, in the three by two pattern. The inner case was constructed of 350-pound bursting-strength test board and the outer case of 250-pound test board. Two boxes that varied only in depth were used. Their inside dimensions were 18¼ by 15⅛ inches and the depths were 7⅝ and 8⅝ inches.

The three-layer pack, including one or two top pads, extended ¾ to 1¾ inches above the top of the inner case. One or two top pads were needed to maintain a tight pack in transit. This pack is referred to in this report as a compression pack. While in storage, the pack settled even with the top of the inner case or to only half an inch above. To maintain pressure during shipment and distribution, two heavy rubberbands were put around each box as it was loaded into the rail cars.

Test packs were shipped with no cushion pads and with one cushion pad between layers. All test packs had one or two compression pads on top of the pack and perforated 1¼ mil polyethylene box liners. Top compression and between-layer pads were combination shredded newsprint and wood excelsior in a kraft paper envelope.

Three benefits accrued from the use of polyethylene liners: They prevented moisture loss, provided a relatively frictionless surface around the pack, and helped maintain a tight pack within the shipping container.

Comparable green and hard pears were shipped in consumer packages and in standard wood boxes.

Results of 10 test shipments made in 1959–60 indicated that prepackaged pears in fiberboard containers could be successfully shipped long distances after normal cold-storage holding periods (table 3). The amount of bruising and discolor-

TABLE 3.—*Arrival condition of Bartlett and Anjou pears in test packs and standard wood boxes shipped from Oregon to eastern markets, 1959-60*

Pear variety and container	Tests	Bruising			Discoloration		
		Slight	Damage	Serious	Slight	Damage	Serious
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
BARTLETT							
Test packs, 15 packages in 3 layers with—							
Nothing between layers	4	1.0	0	0	4.7	0	0
1 cushion pad between layers	4	.3	0	0	1.1	0	0
Standard wood box	4	2.6	.4	0	3.9	0	0
ANJOU							
Test packs, 15 packages in 3 layers with—							
Nothing between layers	6	2.1	0	0	0	0	0
1 cushion pad between layers	6	.1	0	0	.1	0	0
Standard wood box	6	0	0	0	0	0	0

ation in the consumer packages was low and compared favorably with that of pears packed in the standard wood box. These tests also showed that layer pads did not materially decrease bruising and discoloration when green and hard pears were shipped.

Although the three-layer shipping container kept down pear damage, packing cost was too great for commercial use.

Five and Six Layers

Two shipping containers for five- and six-layer packs holding 25 and 30 packages, respectively, were developed to reduce costs. The inside dimensions of the larger containers were 18 inches long by 14¾ inches wide by 14 inches deep, and 12¾ inches deep for 110, 120, and 135 pear sizes. The range of pear sizes packed in these containers is shown in table 4. The three- by two-package pattern, perforated polyethylene box liner, top pads of combination shredded newsprint and wood excelsior, and compression packs were retained (fig. 6).

The results of a preliminary test shipment and 13 controlled test shipments of five- and six-layer packs made in 1960–61 and 1961–62 demonstrated that pears could be prepackaged at harvesttime, held in cold storage from 1 to 6 months, and shipped long distances to market with the expectation that they would arrive in better condition than comparable pears place-packed in the standard wood box (table 5).

The arrival condition of the containers usually was good. Occasionally they were damaged from minor corner creasing, and a few adverse comments were reported about the heavy weight of the five- and six-layer packs.

About 200 carloads of prepackaged pears were shipped by five firms from 1960 to 1964. Examination of 54 of these commercial shipments of Bartlett, Anjou, Bosc, and Comice pears during the 1960–61 and 1961–62 seasons confirmed the results obtained from the controlled test shipments (appendix table 10).

In 1962–63, the arrival condition in eastern markets of seven full carloads of commercial shipments of prepackaged Anjou pears shipped in five- and six-layer containers was satisfactory until December, when the percentages of bruising increased to unsatisfactory levels (appendix table 10, p. 14). This was because some of the pears were partially ripe. Pears that have been improperly stored or for some reason are allowed to ripen before shipment cannot be successfully shipped in the compression packs developed for hard and green pears.

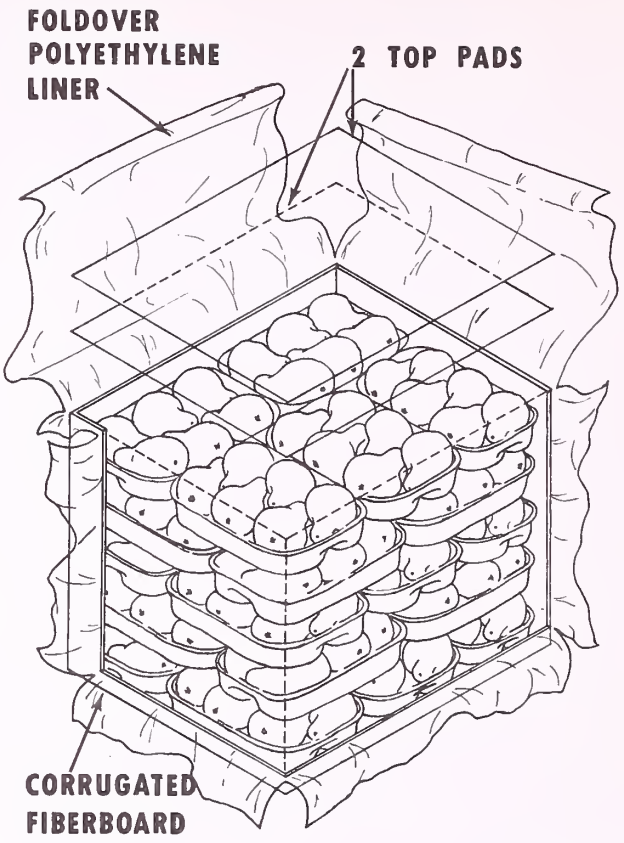

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FIGURE 6.—Components of pack with five layers of consumer packages.

In an effort to develop a pack that would provide greater protection for partially ripened pears, three types of pack were tested: Compression pack, with pads between layers of trays; slack pack, with pads between layers; and compartment pack (fig. 7). The compartment pack was a container with vertical and horizontal partitions. All three packs protected these ripe pears[2] from damage or serious bruising, and slight bruising was very low (appendix table 11). Differences in injury to pears shipped in the three types of pack were not statistically significant. Compartment containers, however, should not be used for long-term shortage (2–6 months) because of the possibility of weakened upright partitions.

[2] Average pressure test (Magness-Taylor 5/16-inch head) was 11.6 pounds at time of shipment and 5.6 pounds at time of evaluation.

TABLE 4.—*Description, capacity, net weight, and standard-box equipment of shipping containers for different sizes of prepackaged pears*

Pear size [1]	Box depth	Layers per box	Pears per package	Packages per box	Calculated net weight of box [2]	Standard-box equivalent [2]
	Inches	*Number*	*Number*	*Number*	*Pounds*	*Factor*
80	14	5	4	25	56.2	1.25
90	14	5	5	25	62.5	1.39
100	14	5	5	25	56.2	1.25
			6	25	67.5	1.50
110	12¾	5	6	25	61.4	1.36
120	12¾	5	6	25	56.2	1.25
135	12¾	5	6	25	50.0	1.11
150	14	6	6	30	54.0	1.20
165	14	6	7	30	57.3	1.27
180	14	6	8	30	60.0	1.33

[1] Based on number of pears packed in standard wood box.
[2] Based on pears sized for 45-pound standard wood box.

TABLE 5.—*Arrival condition of 13 controlled test shipments of Anjou and Bartlett pears in test packs (consumer packages in 5 and 6 layers) and standard wood boxes from west coast to eastern markets, 1960–61 and 1961–62*

Pear shipments and container	Bruising			Discoloration			Stem puncture	Decay
	Slight	Damage	Serious	Slight	Damage	Serious		
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
4 Anjou shipments from Oregon, 1960–61:								
Test packs	0.8	0.2	0	0.2	0	0	0	0.3
Standard wood box	9.8	3.7	0	5.5	0	0	0	.5
4 Bartlett shipments from California, 1961–62:								
Test packs	.2	.1	0	.2	0	0	0	0
Standard wood box	13.6	3.4	0	4.8	2.8	0	0	0
5 Anjou shipments from Washington, 1961–62:								
Test packs	.7	(1)	0	1.7	.1	0	.7	0
Standard wood box	6.1	2.4	0	7.0	0	0	1.2	0

[1] Less than 0.1 percent.

BN-21928

FIGURE 7.—Packs with top pads removed: Left, slack; middle, compartment; right, compression.

COSTS OF PREPACKAGING AND STANDARD PLACE-PACKING

Experimental packaging was done with only slight modifications to the cooperators' packing lines. Methods of pear supply, sorting, sizing, handling, warehousing, and carloading were not changed. Modifications consisted in placing packing stations adjacent to bins containing sized pears and adding conveyor belts to carry the packages through the heat tunnel to accumulator tables. Figure 8 illustrates the packaging of pears in consumer trays at a packing plant and shows the additional equipment used for tray packaging.

Packaging Materials

The packaging materials used for the five- and six-layer packs and the standard wood box are listed in table 6. The higher cost of materials for the packs was for film overwraps and consumer trays.

TABLE 6.—*Cost of materials for packaging pears in consumer packages and for place-packing in standard wood box at 4 plants in California, Oregon, and Washington, 1963–64* [1]

Item	Consumer packages		Standard wood box [4]
	5-layer pack [2]	6-layer pack [3]	
	Cents	*Cents*	*Cents*
Consumer packages:			
Master container	43.3	43.8	----
Pulpboard trays	25.4	29.6	----
Film overwrap, printed	39.0	46.8	----
Polyethylene liner	4.6	4.6	----
Top pad	4.0	4.0	----
Standard wood box:			
Shook-box	----	----	37.0
Shook-lid	----	----	6.5
Label and paste	----	----	.8
Nails	----	----	.2
Chipboard liners	----	----	4.9
Polyethylene liner	----	----	4.4
Pads	----	----	1.9
Treated-paper wraps	----	----	9.0
Pressure-sensitive tape	----	----	.4
Total per box	116.3	128.8	65.1
Total per pound of pears	2.0	2.2	1.4

[1] Costs based on quotations from packers and manufacturers.
[2] 25 packages averaging 59 pounds.
[3] 30 packages averaging 57.1 pounds.
[4] Average 45-pound net weight.

Direct Packing Labor

The direct labor requirements per pound for prepackaging pears and packing them in shipping containers were more than twice as much as for place-packing pears in the standard wood boxes (table 7). Most of the additional labor was needed to fill and wrap the trays. The labor requirements for assembling the master container, supplying materials to packers, packing the trays in the master container, as well as closing it, were greater than required for packing the standard box. It is possible that the cost of prepackaging pears, compared with place-packing them in standard wood boxes, can be reduced with greater industry experience. The use of less skilled labor, rather than the highly skilled labor used in place-packing standard wood boxes, is also a possibility. These factors point toward the feasibility of reducing costs for prepackaging pears in the future.

Transport

Carloads of the five- and six-layer packs of prepackaged pears usually contained 650 boxes. Although 1,000 standard boxes (50,000 pounds) can be loaded in the standard rail car, the 928-box load is generally used. Using 1964–65 transport charges, the cost of transporting a pound of prepackaged pears, based on the most usual composition of carloads of five- and six-layer packs, from the west coast to New York by rail was 2.3 cents compared with 2.2 cents for carloads of pears place-packed in the standard wood box (table 8). The transport cost per pound is higher for prepackaged pears, because fewer pounds normally are loaded in a rail car. But some shippers have loaded enough prepackaged pears of mixed sizes in rail cars to achieve an average transport cost of 2.2 cents a pound.

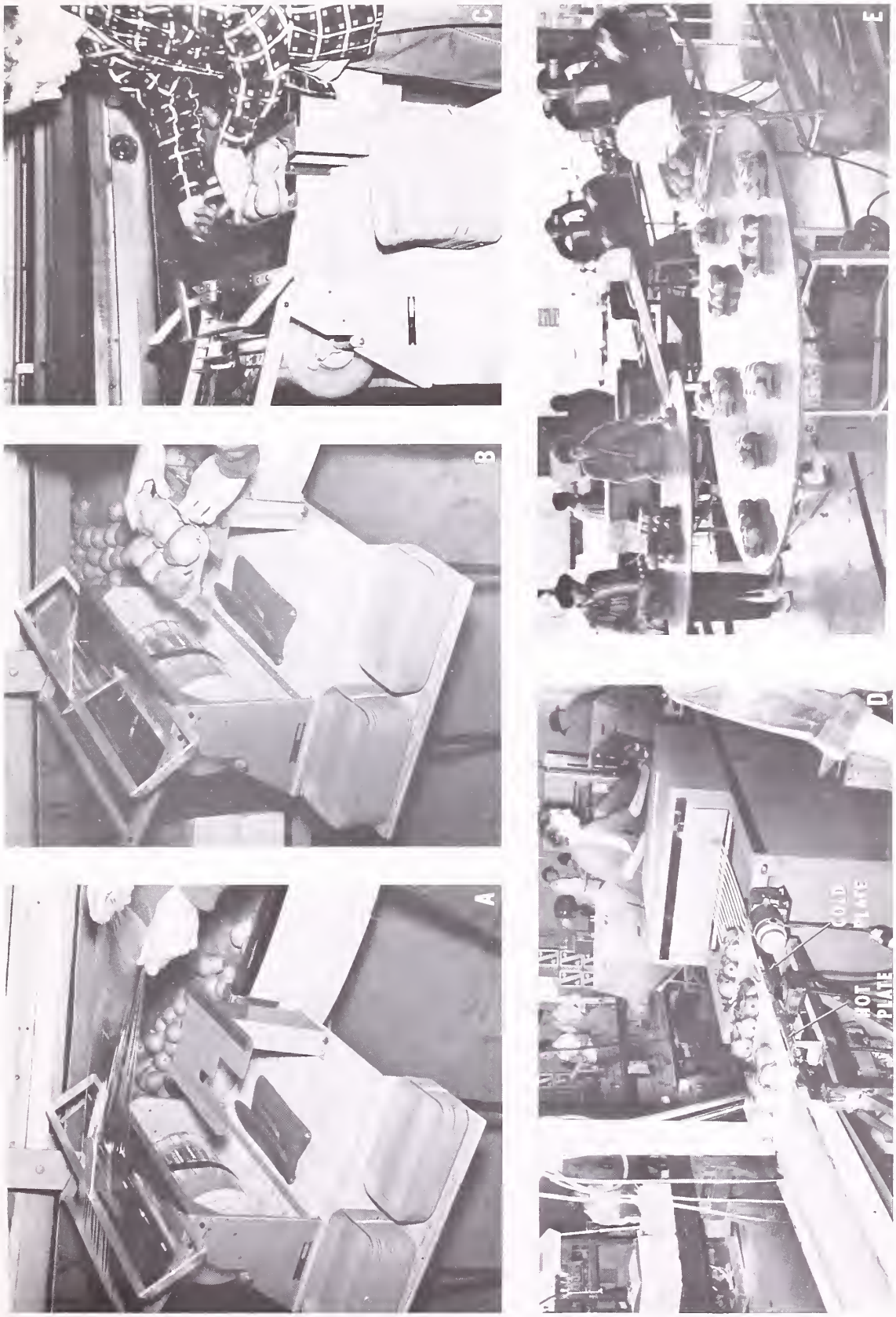

FIGURE 8.—*A*, Packaging station attached to bin containing sized pears; sheet of film is drawn from roll, cut, and draped over mandrel. *B*, Empty tray placed on top of film is filled with pears. *C*, Film is wrapped around filled tray. *D*, Wrapped tray is carried by conveyor belt to hot plate that seals bottom folds, to cold plate that sets seal, and through heat tunnel that shrinks film around package. *E*, Completed packages roll onto accumulator table and packers place them in shipping containers.

BN–26521, BN–26519, BN–26524, BN–26523, BN–26520

TABLE 7.—*Direct packing labor requirements and costs for prepackaging pears in consumer packages and place-packing in standard wood box, by operations, at 4 plants in California, Oregon, and Washington, 1963–64* [1]

Operations	Consumer packages				Standard wood box [4]	
	5-layer pack [2]		6-layer pack [3]			
	Man-minutes	*Cents*	*Man-minutes*	*Cents*	*Man-minutes*	*Cents*
Apply label to box	----	----	----	----	0.08	0.2
Assemble master container	0.52	1.3	0.52	1.3	.26	.6
Insert liners	.30	.8	.30	.8	.26	.6
Supply materials to packers	.65	1.6	.78	2.0	.04	.1
Pack box	----	----	----	----	4.06	10.2
Fill and wrap trays	9.48	23.7	11.38	28.4	----	----
Pack trays in master container	1.97	4.9	2.36	5.9	----	----
Close liner, place pads and lid, weigh, and set off	2.02	5.0	2.02	5.0	.52	1.3
Stamp	.58	1.4	.58	1.4	.21	.5
Rewrap (allowance)	.74	1.8	.90	2.2	----	----
Total per box	16.26	40.5	18.84	47.0	5.43	13.5
Total per pound of pears	.28	.7	.33	.8	.12	.3

[1] Does not include cost of overhead, supervision, office, insurance, fieldmen, or operations common to both types of containers. Labor requirements include 15-percent allowance for fatigue. Labor costs are calculated on basis of average cost of $1.50 per hour.
[2] 25 packages averaging 59 pounds.
[3] 30 packages averaging 57.1 pounds.
[4] Average 45-pound net weight.

TABLE 8.—*Transport charges for prepackaged pears and place-packed pears in standard boxes from Washington and Oregon to New York, N.Y., 1964–65*

Type of pack and number of boxes per carload	Gross weight	Net weight of pears	Cost per carload [1]	Cost per pound of pears
	Pounds	*Pounds*	*Dollars*	*Cents*
Prepackaged,[2] 650	42,055	37,895	870.54	2.3
Standard box,[3] 928	46,400	41,760	918.72	2.2

[1] Weight-incentive freight rates per 100 pounds: 40,000 pounds, $2.07; 46,000 pounds, $1.98.
[2] Pear sizes 90 to 180 average gross weight of 64.7 pounds and net weight of 58.3 pounds per container; pears packed in 5- and 6-layer shipping containers.
[3] Estimated billing weight of 50 pounds and net weight of 45 pounds per shipping container.

Total Costs

It costs 1.1 cents a pound more for packaging materials, direct packing labor, and transportation to market pears in consumer packages than to pack and ship them in standard wood boxes (table 9). This additional cost is comprised of 0.6 cent for packaging materials, 0.4 cent for labor, and 0.1 cent for transport. If the compartment pack or between-layer pads are used to assure more protection to ripened pears, the additional cost for prepackaging pears over the cost of place-packing them in standard wood boxes would be greater. Other differences in costs for storage, supervisory labor, overhead, and "changeover" (for example, adapting plant layouts and techniques and equipment and packing-line techniques) are reported by pear shippers to be another half cent a pound. However, it is likely that changeover costs would gradually disappear if the pear industry prepackaged a greater proportion of the crop and developed more efficient operations.

TABLE 9.—*Cost of packaging materials, direct packing labor, and transport per pound of pears packed and shipped in consumer packages and in standard wood boxes from west coast to New York, N.Y., 1963-64*

Item	Consumer packages [1]	Standard wood box	Difference
	Cents	*Cents*	*Cents*
Packaging materials	2.0	1.4	0.6
Direct packing labor	.7	.3	.4
Transport	2.3	2.2	.1
Total [2]	5.0	3.9	1.1

[1] Based on assumption that ⅘ of pears would be shipped in 5-layer packs and ⅕ in 6-layer packs.

[2] Excludes other costs such as storage, which may be higher for prepackaged pears than for pears packed in standard wood boxes.

WHOLESALE AND RETAIL TRADE REACTION

Wholesale receivers and chainstore warehouse superintendents were usually satisfied with the appearance and condition of the prepackaged pears and with the handling, stacking, and inspection of the fiberboard shipping containers. Some warehouse personnel objected to the heavy weight of the five- and six-layer boxes.

Retailers also were generally satisfied with prepackaged pears when they arrived in near-perfect condition. They reacted unfavorably to "tired looking" packages and to the bruised Anjou pears they received in the partially ripened 1962–63 shipments. Less labor was required to handle and display the prepackaged fruit, and spoilage was reduced. Most produce clerks said the prepackaged pears sold well, but some stores reported slow movement.

Examples of complaints by wholesalers are as follows:

(1) "These boxes (25 to 30 packages per box) are too heavy—at least put handholds in each end."

(2) "The loose and wrinkled film makes the pears look tired and in poor condition."

(3) "Some pears fall out of the ends of the package."

Examples of comments by retailers are as follows:

(1) "I prefer to receive them already prepackaged, ready for display."

(2) "I have to salvage about 7 percent of my pears when using the wood box. I have little or no waste with the prepackaged pears."

(3) A retailer who usually prepackaged in the store said, "I hope to receive more of these packages as it saves me about 20 minutes of labor per box." He also said that it cost him about "3 cents for materials to package six pears."

APPENDIX

TABLE 10.—*Arrival condition of full carloads of commercial shipments of prepackaged pear varieties packed in 5- and 6-layer fiberboard containers from Oregon to eastern markets, 1960–61*

BARTLETT, 16 CARLOADS

Date shipped	Bruising			Discoloration			Stem puncture	Decay
	Slight	Damage	Serious	Slight	Damage	Serious		
1960	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
August	0	0	0	0	0	0	0	0
October	0	0	0	.3	0	0	.6	0
Do	.1	0	0	.2	0	0	.2	0
Do	0	0	0	0	0	0	0	0
Do	0	0	0	0	0	0	.6	0
Do	0	0	0	0	0	0	0	0
Do	.1	0	0	.7	0	0	.2	0
Do	0	0	0	.4	0	0	0	0
Average	(1)	0	0	.2	0	0	.2	0
1961								
September	1.0	0	0	.7	0	0	.4	0
Do	.4	0	0	.4	0	0	0	0
Do	.3	0	0	0	0	0	0	0
Do	0	0	0	0	0	0	.1	0
October	.2	0	0	.1	0	0	.5	0
Do	.3	0	0	0	0	0	.5	.5
Do	0	0	0	0	0	0	.3	.2
Do	0	0	0	0	0	0	0	0
Average	.3	0	0	.2	0	0	.2	.1

ANJOU, 22 CARLOADS

1960								
October	0	0	0	0.2	0.1	0	0.5	0
Do	0	0	0	0	0	0	.7	0
Do	0	0	0	.5	0	0	.5	0
November	0	0	0	.2	0	0	.5	0
Do	0	0	0	0	0	0	.2	0
Do	0	0	0	0	0	0	.2	0
Do	.1	0	0	0	0	0	.1	0
Do	.1	0	0	0	0	0	.4	.1
Do	0	0	0	0	0	0	0	0
December	.3	0	0	1.7	0	0	.3	0
Do	0	0	0	4.0	0	0	.8	0
Do	0	.5	0	0	0	0	.3	0
Do	0	0	0	3.6	0	0	.4	0
1961								
January	.1	0	0	2.3	0	0	.4	0
Average	(1)	(1)	0	.9	(1)	0	.4	(1)
1961								
October	.1	0	0	.1	0	0	0	0
November	.1	0	0	.1	.1	0	.5	0
Do	.9	.2	0	0	0	0	0	0
Do	1.1	.2	0	0	0	0	0	0
Do	.3	0	0	0	0	0	.5	0
Do	.7	0	0	0	0	0	2.4	0
1962								
January	1.2	0	0	5.0	.7	0	0	0
Do	.2	0	0	1.1	0	0	0	0
Average	.6	(1)	0	.8	.1	0	.4	0

BOSC, 14 CARLOADS

Date shipped	Bruising			Discoloration			Stem puncture	Decay
	Slight	Damage	Serious	Slight	Damage	Serious		
1960	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
October	0	0	0	0.1	0	0.1	1.1	0
Do	.1	0	0	.7	0	0	.2	0
Do	0	0	0	0	0	0	.3	0
November	1.4	.7	0	3.4	0	0	2.3	.1
Do	.1	0	0	0	0	0	1.0	0
Do	0	0	0	0	0	0	.6	0
Do	0	0	0	0	0	0	.5	0
December	0	.1	0	3.1	0	0	.8	0
Average	.2	.1	0	.9	0	(1)	.8	(1)
1961								
October	0	0	0	.1	0	0	0	0
November	0	0	0	0	0	0	2.0	0
Do	.3	0	0	0	0	0	1.0	0
Do	.1	0	0	0	0	0	1.4	0
Do	.5	0	0	0	0	0	2.4	0
1962								
January	0	0	0	0	0	0	.2	.5
Average	.2	0	0	(1)	0	0	1.2	.1

COMICE, 2 CARLOADS

1961								
December	0	0	0	0.4	0	0	0	0
Do	.2	0	0	.2	0	0	0	0
Average	.1	0	0	.3	0	0	0	0

ANJOU, 7 CARLOADS [2]

1962								
November	0	0	0	0.3	0	0	--------	0
Do	2.4	0	0	.1	0	0	--------	0
Do	7.7	0	0	.7	0	0	--------	0
December	17.6	0	0	.2	0	0	--------	0
1963								
January	41.3	1.7	0	2.5	0	0	--------	1.0
Do	51.7	1.8	0	2.0	0	0	--------	.6
Do	31.8	.2	0	0	0	0	--------	.8
Average	21.8	.5	0	.8	0	0	--------	.3

[1] Less than 0.1 percent.
[2] Fruit of varying maturity.

TABLE 11.—*Arrival condition of test shipments of prepackaged Anjou pears in 3 types of pack from Yakima, Wash., to New York, N.Y., March and April 1964*

Pear size and type of pack	Tests	Bruising			Discoloration		
		Slight	Damage	Serious	Slight	Damage	Serious
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
110:							
Compression	2	3.7	0.3	0	0.2	0.2	0
Slack	2	1.2	0	0	.4	0	0
Compartment	2	1.4	0	0	.3	0	0
150:							
Compression	2	2.8	0	0	.5	0	0
Slack	2	.8	0	0	.4	0	0
Compartment	2	0	.1	0	.3	0	0
Average:							
Compression	4	3.2	.2	0	.4	.1	0
Slack	4	1.0	0	0	.4	0	0
Compartment	4	.7	(1)	0	.3	0	0

[1] Less than 0.1 percent.

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